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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/067,616	02/04/2002	Ruey-Jen Hwu	ISYS117272	7600

26389 7590 06/11/2003

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EXAMINER
DONG, DALEI

ART UNIT	PAPER NUMBER
2875	

DATE MAILED: 06/11/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/067,616	Applicant(s) HWU ET AL.
	Examiner Dalei Dong	Art Unit 2875

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1 136(a) In no event, however may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C § 133)
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed may reduce any earned patent term adjustment See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 May 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-41,44 and 45* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-41,44 and 45* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *04 February 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-7, 15-16, 19, 39-40 and 44-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,841,219 to Sadwick.

Regarding to claims 1, 3-5, 7, 15-16, 19, 39-40 and 44-45 Sadwick discloses in Figure 1A, a device "Deposited on the substrate 4 ***(substrate)*** are the component parts of the microminiature vacuum tube device, with these parts being shown greatly enlarged and out of scale to better illustrate the structure. A low resistance metal 8, such as gold, aluminum, intermetallic or the like, is deposited on the substrate 4 about a void 12. Deposited or formed over the void 12 and partially over the low resistance metal 8 is an element 16 which will serve as the cathode filament of the vacuum tube device. The cathode filament 16 ***(cathode)*** is placed in contact with the low resistance metal 8 since it is via this layer that the cathode filament will be stimulated to emit electrons. As will be described later, this will be carried out by heating the cathode filament to cause it to thermionically emit the electrons. Disposition of the cathode filament 16 over the void 12 serves to reduce the thermal load and stress which might otherwise be imposed on the vacuum tube device during operation. In effect, the void 12 serves to localize the cathode

filament heating element 16 to contain the heat therein. Advantageously, the cathode filament 16 is made of a refractory metal such as molybdenum, platinum, titanium, tungsten, or the like. These materials have a relatively low coefficient of expansion which, because of the small distances which will be present between the component parts of the vacuum tube device, are desirable to minimize the possibility of the component parts thermally expanding or growing to ultimately touch. The latter event, of course, would disable the vacuum tube device" (column 3, line 10-37).

Sadwick also discloses in Figure 1A, "a resistive material 20 ***(raised support formed on the substrate by a stacked structure)*** is deposited on the low resistance metal 8 and formed to define a void 24 which surrounds the cathode filament 16. The resistive material 20 might illustratively be ceramic, silicon dioxide or the like" (column 3, line 38–41).

Sadwick further discloses in Figure 1A, "deposited on the resistive material 20 is an electrically conductive grid layer 28 ***(grid comprising of elongated conductive strip forming at least one aperture and positioned between the cathode and the anode)***, a portion of which 30 projects into the void 24 to define an opening 32 positioned directly above the cathode filament 16. The grid layer 28 might illustratively be made of tungsten, gold, tantalum or the like. The grid layer 28, and in particular the projections 30, serve as a conventional grid in a triode vacuum tube structure" (column 3, line 42-48).

Sadwick further yet discloses in Figure 1A, "deposited on the grid layer 28 is another layer of resistive material 34, formed to define a void 36 which is above the

opening 32 in the grid layer 28, as shown in FIG. 1A. The resistive material 34 may be the same as the resistive material of layer 20" (column 3, line 49-53).

Sadwick further yet discloses in Figure 1A, "deposited on the resistive layer 34 to bridge over the void 36 is an electrically conductive anode 40. The electrically conductive material 40 may be the same as the electrically conductive material of layer 28. As can be seen, the anode 40 is positioned vertically above the void 36, the opening 32 in the grid layer 28, the void 24, and the cathode filament 16. This provides a vertically oriented, solid-state thermionic, triode vacuum tube device which is immune to high temperatures and harsh environments such as those with high radiation" (column 3, line 54-63).

Sadwick finally discloses in Figure 3A and 3B, "an alternative embodiment of a microminiature vacuum tube made in accordance with the present invention. The FIG. 3A device is also a cross-sectional view, and shows a construction very similar to the FIG. 1A device except that the layer of low resistance metal 8 is thinner than that of the FIG. 1A device, the substrate 4 is thicker and includes a column void 12 ***(cavity extending into the substrate, and the cathode and the cavity are configured to form an air gap between the substrate and the cathode)*** formed in the substrate 4 directly below the cathode filament 16. The purpose of the column void 12 is to localize and isolate the cathode filament 16 to reduce the thermal load and stress which might otherwise occur on the other components of the device. The other components and structure of the device of FIG. 3A are similar to those of FIG. 1" (column 4, line 50-62).

Sadwick does not discloses a cathode having an electron-emitting coating disposed thereon, however, Sadwick teaches the cathode filament will be stimulated to emit electrons where the cathode consist of a electron emitting material, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have compose the cathode with an electron-emitting material in order to reduce the power consumption of the cathode and enhance the efficiency of the electrons emitted by the cathode.

Regarding to claim 2, "the device of FIG. 1A would be operated in essentially the same fashion as that of a conventional vacuum tube including a source of thermal energy 44 coupled to the low resistance metal layer 8 for providing heat to heat the cathode filament 16 and cause it to emit electrons. The thermal source of energy 44 might illustratively simply be a voltage source for supplying a current to the low resistance metal layer 8 to flow through the cathode filament 16, causing it to heat and emit electrons. Coupled to the grid layer 28 is a control voltage source 48 ***(one control circuit)*** for selectively applying a voltage to the grid layer to control the flow of electrons through the opening 32 of the grid layer, from the cathode filament 16. Of course, controlling the flow of electrons through the opening 32 effectively controls the electrons reaching the anode 40 which, by reason of a positive anode voltage source 52, attracts and receives the electrons to develop a desired electrical current. Such operation of the microminiature vacuum tube device of FIG. 1A is well-known" (column 3, line 64 to column 4, line 14).

Regarding to claim 6, Sadwick discloses the claimed invention except for the cathode is affixed to the substrate at opposite ends of the cathode. It would have been obvious to one having ordinary skill in the art at the time the invention was made to have switch the orientation of the cathode where the cathode affixed to the substrate at opposite ends of the cathode in order to provide a larger cavity to further localize and isolate the cathode to reduce the thermal load and stress; furthermore since it has been held that rearranging parts of an invention involves only routine skill in the art. *In Re Japikse,* USPQ 70.

3. Claims 8-9 and 12-13 rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,841,219 to Sadwick in view of U.S. Patent No. 6,091,189 to Shinjo.

Regarding to claims 8-9 and 12-13, Sadwick discloses a device comprising a substrate having a cavity extending into a surface of the substrate; a cathode having an electron emitting coating disposed thereon, wherein the cathode is suspended near the opening of the cavity in the substrate, wherein the cathode and the cavity are configured to form an air gap between the substrate and the cathode for providing a thermal barrier around the cathode; an anode constructed of an electrically conductive material, wherein the anode is configured to received electrons emitted by the cathode, and wherein the anode is configured to produce an electrical current from the received electrons, wherein the anode is configured to communicate the electrical current o an external circuit: a grid forming at least one aperture for alloing the passage of electrons therethrough, wherein the grid is constructed of an electrically conductive material, and wherein the grid is

positioned between the cathode and anode; a seal for creating a controlled environment in an area surrounding the anode, cathode and grid; and a circuit configured for heating the cathode.

However, Sadwick fails to teach an electron emitting material made of BaSrCa tricarbonate and scandia and scandate. Shinjo teaches "an electron emitting substance layer that is formed by being deposited to cover surfaces of the metal layer 40 and a total of a surface of the base body 1 at the outer peripheral portion of the metal layer 40. The electron emitting substance layer 50 includes at least barium (Ba), the major component of the layer is constituted by alkaline earth metal oxides including strontium (Sr) and/or calcium (Ca) and the layer includes rare earth metal oxides of scandium oxide (Sc.sub.2 O.sub.3) etc. by 0.1 through 20% by weight" (column 14, line 34-43).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have composed the cathode of Sadwick utilizing the electron-emitting layer of Shinjo in order to facilitate electron emitted and improve the strength of the cathode and thus better suited to sustain stress and furthermore simply and furthermore inexpensively manufacture the device.

Furthermore, Sadwick discloses the claimed invention except for the claimed electron-emitting material. It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the claimed electron-emitting material, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin,* 125 USPQ 416.

4. Claims 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,841,219 to Sadwick in view of U.S. Patent No. 6,184,610 to Shibata.

Regarding to claims 10 and 11, Sadwick discloses a device comprising a substrate having a cavity extending into a surface of the substrate; a cathode having an electron emitting coating disposed thereon, wherein the cathode is suspended near the opening of the cavity in the substrate, wherein the cathode and the cavity are configured to form an air gap between the substrate and the cathode for providing a thermal barrier around the cathode; an anode constructed of an electrically conductive material, wherein the anode is configured to received electrons emitted by the cathode, and wherein the anode is configured to produce an electrical current from the received electrons, wherein the anode is configured to communicate the electrical current o an external circuit; a grid forming at least one aperture for allowing the passage of electrons therethrough, wherein the grid is constructed of an electrically conductive material, and wherein the grid is positioned between the cathode and anode; a seal for creating a controlled environment in an area surrounding the anode, cathode and grid; and a circuit configured for heating the cathode.

However, Sadwick fails to teach an electron emitting material made of BaSrAl and thoriated tungsten. Shibata teaches a electron-emitting material "made of any highly conducting material, preferably candidate materials include metal such as Ni, Cr, Au, Mo, W, Pt, Ti, Al, Cu, and Pd and their alloys, printable conducting materials made of a metal or a metal oxide selected from Pd, Ag, RuO_2, Pd-Ag and glass, transparent

conducting materials such as In_2O_3-SnO_2 and semiconductor material such as polysilicon" (column 6, line 10-16).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have compose the cathode of Sadwick utilizing the electron-emitting layer of Shibata in order to facilitate electron emitted and improve the strength of the cathode and thus better suited to sustain stress and furthermore simply and furthermore inexpensively manufacture the device.

Furthermore, Sadwick discloses the claimed invention except for the claimed electron-emitting material. It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the claimed electron-emitting material, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin,* 125 USPQ 416.

5. Claims 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,841,219 to Sadwick in view of U.S. Patent No. 6,051,923 to Pong.

Regarding to claim 14, Sadwick discloses a device comprising a substrate having a cavity extending into a surface of the substrate; a cathode having an electron emitting coating disposed thereon, wherein the cathode is suspended near the opening of the cavity in the substrate, wherein the cathode and the cavity are configured to form an air gap between the substrate and the cathode for providing a thermal barrier around the cathode: an anode constructed of an electrically conductive material, wherein the anode is

configured to received electrons emitted by the cathode, and wherein the anode is configured to produce an electrical current from the received electrons, wherein the anode is configured to communicate the electrical current o an external circuit; a grid forming at least one aperture for allowing the passage of electrons therethrough, wherein the grid is constructed of an electrically conductive material, and wherein the grid is positioned between the cathode and anode; a seal for creating a controlled environment in an area surrounding the anode, cathode and grid; and a circuit configured for heating the cathode.

However, Sadwick fails to teach an electron emitting material made of cesium. Pong teaches "electron emitting part 40 may be of any materials having suitable surface work function, such as refractory metals, e.g. tungsten, tungsten alloys, molybdenum or molybdenum alloys, tungsten or tungsten alloys modified with thorium, cesium, barium or lanthanum, or alloys thereof or the like" (column 3, line 20-25).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have compose the cathode of Sadwick utilizing the electron-emitting layer of Pong in order to facilitate electron emitted and improve the strength of the cathode and thus better suited to sustain stress and furthermore simply and furthermore inexpensively manufacture the device.

Furthermore, Sadwick discloses the claimed invention except for the claimed electron-emitting material. It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the claimed electron-emitting material, since it has been held to be within the general skill of a worker in the art to

select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin,* 125 USPQ 416.

6. Claims 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,841,219 to Sadwick in view of U.S. Patent No. 5,973,444 to Xu.

Regarding to claims 17 and 18, Sadwick discloses a device comprising a substrate having a cavity extending into a surface of the substrate; a cathode having an electron emitting coating disposed thereon, wherein the cathode is suspended near the opening of the cavity in the substrate, wherein the cathode and the cavity are configured to form an air gap between the substrate and the cathode for providing a thermal barrier around the cathode; an anode constructed of an electrically conductive material, wherein the anode is configured to received electrons emitted by the cathode, and wherein the anode is configured to produce an electrical current from the received electrons, wherein the anode is configured to communicate the electrical current o an external circuit; a grid forming at least one aperture for allowing the passage of electrons therethrough, wherein the grid is constructed of an electrically conductive material, and wherein the grid is positioned between the cathode and anode; a seal for creating a controlled environment in an area surrounding the anode, cathode and grid; and a circuit configured for heating the cathode.

However, Sadwick fails to teach the grid contains carbon-containing material and silicide. Xu teaches a non-limiting example of gate electrodes, include W, Mo, Al, Cr, Pt, Au, Ag, Cu, polysilicon, silicides and mixtures thereof" (column 10, line 23-25).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have constructed the grid of Sadwick using the gate-electrode material of Xu in order to better control electron emitted and improve the strength of the cathode and thus better suited to sustain stress and furthermore simply and furthermore inexpensively manufacture the device.

Furthermore, Sadwick discloses the claimed invention except for the claimed grid material. It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize the claimed grid material, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin,* 125 USPQ 416.

7. Claims 20 and 41are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,841,219 to Sadwick in view of U.S. Patent No. 5,397,957 to Zimmerman.

Regarding to claims 20 and 41, Sadwick discloses a device comprising a substrate having a cavity extending into a surface of the substrate; a cathode having an electron emitting coating disposed thereon, wherein the cathode is suspended near the opening of the cavity in the substrate, wherein the cathode and the cavity are configured to form an air gap between the substrate and the cathode for providing a thermal barrier around the cathode; an anode constructed of an electrically conductive material, wherein the anode is configured to received electrons emitted by the cathode, and wherein the anode is configured to produce an electrical current from the received electrons, wherein the

anode is configured to communicate the electrical current o an external circuit; a grid forming at least one aperture for allowing the passage of electrons therethrough, wherein the grid is constructed of an electrically conductive material, and wherein the grid is positioned between the cathode and anode; a seal for creating a controlled environment in an area surrounding the anode, cathode and grid; and a circuit configured for heating the cathode.

However, Sadwick fails to teach the controlled environment is an enclosed area filled with a gas selected from the group consisting of hydrogen, helium, krypton, argon and mercury. Zimmerman teaches "Many combinations of insulators and conductors may be used in the fabrication procedures and device structures described. Specific applications may dictate special material properties such as resistivity, dielectric constant, thermal stability, physical strength, etc. but in general there are three basic requirements for compatibility. First, the materials must be compatible with the processing required for fabrication which may limit some material combinations in particular fabrication regimes. Second, their must be adequate adhesion between adjacent layers. Third, the materials must be stable and not contaminate the operating environment of the vacuum devices which is typically a moderate to high vacuum. This last requirement is somewhat open because some of these devices may be able to operate in up to 1 atmosphere or more of a high ionization potential gas such as He. This may be possible because their microscopic dimensions provide very small path lengths and allow the use of low extraction voltages" (column 15, line 6-24).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have utilize the ionization potential gas of Zimmerman for the thermionic vacuum tube of Sadwick in order to provide a device which may be utilized in a generally harsh environments, and in high electrical power and high frequency applications.

8. Claims 21-28 and 30-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,841,219 to Sadwick in view of U.S. Patent No. 5,850,120 to Okamoto.

Regarding to claims 21-25, 27-28, 30-34 and 36-37, Sadwick discloses a device comprising a substrate having a cavity extending into a surface of the substrate; a cathode having an electron emitting coating disposed thereon, wherein the cathode is suspended near the opening of the cavity in the substrate, wherein the cathode and the cavity are configured to form an air gap between the substrate and the cathode for providing a thermal barrier around the cathode; an anode constructed of an electrically conductive material, wherein the anode is configured to received electrons emitted by the cathode, and wherein the anode is configured to produce an electrical current from the received electrons, wherein the anode is configured to communicate the electrical current o an external circuit; a grid forming at least one aperture for allowing the passage of electrons therethrough, wherein the grid is constructed of an electrically conductive material, and wherein the grid is positioned between the cathode and anode; a seal for creating a controlled environment in an area surrounding the anode, cathode and grid; and a circuit configured for heating the cathode.

However, Sadwick does not disclose a second grid forming at least one aperture for allowing the passage of electrons therethrough. Okamoto teaches in Figure 6, "A cathode 1 is provided on a substrate 4, which has a cone shape with a top sharp-pointed. A first insulation film 5 is provided on the substrate 4 and has an opening portion which surrounds the cathode 1. The first insulation film 5 has a circular-shaped opening portion which surrounds the cone-shaped cathode 1 via a gap. The thickness of the first insulation film 5 is smaller than a height of the cone-shaped cathode 1. A primary gate electrode 2 made of a metal is formed on the first insulation film 5. The primary gate electrode 2 has the opening portion which surrounds of the cone-shaped cathode 1. A second insulation film 6 is provided on the primary gate electrode 2. A secondary gate electrode 3 ***(second grid forming at least one aperture for allowing the passage of electrons and constructed of an electrically conductive material)*** having an opening portion is provided on the second insulation film 6 so that the secondary gate electrode 3 is electrically separated from the primary gate electrode 2. A third insulation film 9 is provided on the secondary gate electrode 3. A ternary gate electrode 10 having an opening portion is provided on the third insulation film 9 so that the ternary gate electrode 10 ***(third grid forming at least one aperture for allowing the passage of electrons and constructed of an electrically conductive material)*** is electrically separated from the secondary gate electrode 3" (column 8, line 52 to column 9, line 5).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have utilize the second grid electrode of Okamoto for the thermionic vacuum tube of Sadwick in order to improve the gate structure for allowing

electrons emitted from the cathode to have an approximately minimum ratio of the average of a traveling-parallel velocity component.

Regarding to claims 26 and 35, Sadwick discloses the claimed invention except for the cathode is affixed to the substrate at opposite ends of the cathode. It would have been obvious to one having ordinary skill in the art at the time the invention was made to have switch the orientation of the cathode where the cathode affixed to the substrate at opposite ends of the cathode in order to provide a larger cavity to further localize and isolate the cathode to reduce the thermal load and stress; furthermore since it has been held that rearranging parts of an invention involves only routine skill in the art. *In Re Japikse,* USPQ 70.

9. Claims 29 and 38 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,841,219 to Sadwick in view of U.S. Patent No. 5,850,120 to Okamoto in further view of U.S. Patent No. 5,397,957 to Zimmerman.

Regarding to claims 29 and 38, Sadwick discloses a device comprising a substrate having a cavity extending into a surface of the substrate; a cathode having an electron emitting coating disposed thereon, wherein the cathode is suspended near the opening of the cavity in the substrate, wherein the cathode and the cavity are configured to form an air gap between the substrate and the cathode for providing a thermal barrier around the cathode; an anode constructed of an electrically conductive material, wherein the anode is configured to received electrons emitted by the cathode, and wherein the anode is

configured to produce an electrical current from the received electrons, wherein the anode is configured to communicate the electrical current o an external circuit; a grid forming at least one aperture for allowing the passage of electrons therethrough, wherein the grid is constructed of an electrically conductive material, and wherein the grid is positioned between the cathode and anode; a seal for creating a controlled environment in an area surrounding the anode, cathode and grid; and a circuit configured for heating the cathode.

However, Sadwick does not disclose a second grid and a controlled environment filled with a gas. Okamoto teaches a second grid electrode however, fails to teach a controlled environment filled with a gas.

Zimmerman teaches "Many combinations of insulators and conductors may be used in the fabrication procedures and device structures described. Specific applications may dictate special material properties such as resistivity, dielectric constant, thermal stability, physical strength, etc. but in general there are three basic requirements for compatibility. First, the materials must be compatible with the processing required for fabrication which may limit some material combinations in particular fabrication regimes. Second, their must be adequate adhesion between adjacent layers. Third, the materials must be stable and not contaminate the operating environment of the vacuum devices which is typically a moderate to high vacuum. This last requirement is somewhat open because some of these devices may be able to operate in up to 1 atmosphere or more of a high ionization potential gas such as He. This may be possible because their

microscopic dimensions provide very small path lengths and allow the use of low extraction voltages" (column 15, line 6-24).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have utilize second electrode of Okamoto and the ionization potential gas of Zimmerman for the thermionic vacuum tube of Sadwick in order to provide a device which may be utilized in a generally harsh environments, and in high electrical power and high frequency applications and furthermore provide an improved structure for allowing electrons emitted from the cathode to have an approximately minimum ratio of the average of a traveling-vertical component.

Response to Arguments

10. Applicant's arguments with respect to claims 1-41 and 44-45 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

The following prior art are cited to further show the state of the art of composition of a device.

U.S. Patent No. 5,141,459 to Zimmerman.

U.S. Patent No. 5,334,908 to Zimmerman.

U.S. Patent No. 5,493,177 to Muller.

U.S. Patent No. 5,561,345 to Kuo.

U.S. Patent No. 5,955,828 to Sadwick.

U.S. Patent No. 6,157,123 to Schmid.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dalei Dong whose telephone number is (703)308-2870. The examiner can normally be reached on 8 A.M. to 5 P.M..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sandra O'Shea can be reached on (703)305-4939. The fax phone numbers for the organization where this application or proceeding is assigned are (703)872-9318 for regular communications and (703)872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703)308-0956.

D.D.
June 4, 2003